

A new species of deep-water skate, *Breviraja africana* sp. n.
(Pisces, Batoidea, Rajidae),
from the Eastern Central Atlantic slope,
and remarks on the taxonomic status
of *Breviraja* Bigelow & Schroeder, 1948

by Matthias STEHMANN and Bernard SERET

Abstract. — Three specimens (1 adult ♂, 2 ♀♀) of a deep-water dwarf species of skate were obtained by the authors during the course of their investigations for the batoid volume of ORSTOM's "Faune tropicale". These specimens from 900-1 030 m depth off Gabon are described as *Breviraja africana* sp. n., which in the Eastern Atlantic forms the geographic link between three species known from the NE-Atlantic and another one from the SE-Atlantic off South Africa. McEACHRAN & COMPAGNO (1982) revised the genus *Breviraja* Bigelow & Schroeder, 1948, mainly on anatomical characters such as neurocranium, scapulocoracoid, and skeleton of the clasper as well as its external morphology. The investigation by these authors resulted in ordering the species into newly defined taxa, i.e. *Breviraja* for the minority, and *Neoraja* gen. n. for the majority of species, the latter taxon being subdivided into the new subgenera *Neoraja* and *Fenestrija*. *Breviraja africana*, as described in the present contribution based on the complete range of modern taxonomic characters, appears intermediate between *Breviraja* and *Neoraja* with regard to the diagnostic features given by McEACHRAN & COMPAGNO (1982). This mainly urged the present authors to briefly discuss the revision of the latter authors and to propose a renewed consideration of the status of *Breviraja* Bigelow & Schroeder, 1948, to which the new species is assigned preliminarily until such a careful consideration of the generic situation can be undertaken at another occasion.

Résumé. — Trois exemplaires (1 mâle adulte et 2 femelles) d'une petite espèce de raie de profondeur ont été récoltés au cours des recherches effectuées dans le cadre de l'étude que nous menons sur les poissons batoïdes de l'Est-Atlantique tropical. La synthèse de cette étude fera l'objet d'un numéro spécial de la série « Faune tropicale » de l'ORSTOM. L'espèce nouvelle *Breviraja africana* est décrite à partir de ces trois exemplaires, qui ont été chalutés par 900-1 030 m de profondeur au large des côtes du Gabon. Elle établit la liaison géographique entre les trois espèces connues de l'Atlantique-NE et celle de l'Atlantique-SE (Afrique du Sud). McEACHRAN & COMPAGNO (1982) ont révisé le genre *Breviraja* Bigelow & Schroeder, 1948, en se fondant principalement sur les caractères anatomiques tels que le neurocrâne, le complexe scapulocoracoïde, le squelette et la morphologie externe des ptérygopodes. Des recherches de ces auteurs, il résulte que les espèces sont classées dans deux genres, i.e. *Breviraja* redéfini par McEACHRAN & COMPAGNO, qui comprend quelques-unes des espèces, et *Neoraja* gen. n. qui regroupe la plupart d'entre-elles ; ce dernier taxon étant lui-même divisé en deux nouveaux sous-genres *Neoraja* et *Fenestrija*. *Breviraja africana*, dont la présente description est fondée sur l'intégralité des caractères taxonomiques modernes, apparaît intermédiaire entre *Breviraja* et *Neoraja*, selon les caractéristiques des diagnoses données par McEACHRAN & COMPAGNO (1982). De cette situation, nous avons été amenés à débattre de la révision effectuée par McEACHRAN & COMPAGNO, et à proposer une nouvelle réflexion sur

le status du genre *Breviraja* Bigelow & Schroeder, 1948, auquel la nouvelle espèce est provisoirement rattachée, en attendant qu'une telle réflexion puisse être entreprise.

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INTRODUCTION

In the course of the authors' cooperation in the ORSTOM research project for the purpose of preparing the batoid volume of "Faune tropicale" one of us, B. SERET, worked in the ORSTOM Center in Dakar for several years in order to study the local fauna and collection material in Gorée as well as Pointe Noire, and to obtain study material from fishmarkets, fishermen and through participation in research cruises of various vessels. A number of species unknown for the Eastern Central Atlantic or even for science were discovered, partly in scientific collections, but mainly during deep-trawling surveys along the continental slope.

It is the purpose of the present contribution to introduce a new rajid species from the slope off Gabon prior to the main inventory and revision publication. Other papers of this nature may follow.

The three type specimens were collected by B. SERET during the survey *Seraie* with the RV 'Nizery' off Gabon in April 1980. The holotype and one paratype will be deposited in the collection of the Muséum national d'Histoire naturelle (MNHN) in Paris, the other paratype in the collection of the Institut für Seefischerei in Hamburg (ISH).

Breviraja africana sp. n.

MATERIAL EXAMINED : Holotype : MNHN 1983-1, adult ♂ of 288 mm TL. RV 'Nizery' cruise *Seraie*, stat. 35, 18.IV.1980 ; 03°25' S, 09°33' E, 900-1 030 m depth, T_b 4.35° C, 9.6 m otter trawl. — Two paratypes : ISH 129/80, ♀ 304 mm TL. Capture data as for the holotype. — MNHN 1983-2, ♀ 284 mm TL. RV 'Nizery' cruise *Seraie*, stat. 32, 17.IV.1980 ; 02°41' S, 08°51' E, 900-930m depth, T_b 4.66° C, 9.6 m otter trawl.

DIAGNOSIS

A dwarf-species of rajid skate of the genus *Breviraja* Bigelow & Schroeder, 1948, with a maximum total length of about 300 mm. The new species is characterized by the combination of the following characters : Disc almost heart-shaped, with broadly rounded outer corners. Snout very short, bluntly angled (about 135°), and with a short triangular integumental process at its tip. Tail long and rather slender, its length just under 60 % of the TL. Anterior pelvic lobe slender and as long as about 75 % of the length of the posterior lobe. The two small dorsal fins very posterior on tail and with confluent bases, caudal fin with a low ventral fold. Nasal flaps and rear margin of nasal curtain fringed. Anterior disc margins strongly undulated in adult males.

Upper side of disc and tail entirely and densely set with coarse spinules, except for posterior disc margins and origin as well as center of pectorals in adult males. 3-4 small preorbital thorns and 1-3 in postorbital position. At most a single posterior nuchal thorn and one on each shoulder.

No further thorns on disc, except for malar and alar thorns in adult males. A median row of 17-28 thorns from level of pelvic axils along anterior three fifths of tail length, the remaining section to first dorsal fin a narrow, shallow groove without thorns or spinules. Lower side smooth, narrow strips of spinules may occur only along edges of tail. 45-49 tooth rows in upper jaws. Teeth flattened and in quincunx arrangement in juveniles and females, but pointed and in parallel rows in adult males.

Colour after preservation plain greyish-brown above, darker to margins of disc and pelvics. Several indistinct dark brown crossbars over tail length. Lower side predominantly white, but a broad brown border along margins of disc and pelvics, and anterior two thirds of tail brown. Head also largely brown, and brown blotches may occur on belly, inner pectorals and around anus. Fresh specimens with a distinct bluish shade on head and margins of disc and pelvics above, and margins of disc and pelvics below blackish rather than brown in fresh state.

Upper side of clasper, which is moderately elongate and slender, with dermal denticles and a very large pseudosiphon, formed and supported in its distal third by dT1-cartilage. Glans clasper with components as generally described for other members of the genus, but particularly with terminal bridge, pseudorhipidion, rhipidion, flag, dike, and funnel. Clasper skeleton consisting of 4 dT-, 2 aT-cartilages and a ventral terminal. Dorsal marginal with distal extension, dT1 with proximal process and fused distally with the vT. Dorsal terminal 3 not fused with axial or dT4, which joins tip of axial, and ventral terminal with anterior notch and medial process.

Neurocranium with rostral cartilage very delicate in its distal two thirds and joined to rostral node. Rostral appendices very elongate and flattened. Nasal capsules very large, ovoid in shape, without basal fenestrae. Preorbital processes and jugular arches poorly developed. Anteriormost pectoral radials and propterygia almost in contact with rostral appendices at snout tip.

Scapulocoracoid subquadrangular and hardly expanded anteroposteriorly. Foramina expanded, only one postventrally. Rear corner not elevated, and postdorsal margin abruptly sloping. Mescondyle almost equidistant to both the other condyles.

Vtr : 23-24, Vprd : 68-70, pectoral radials : 61-63.

ETYMOLOGY : Named after its type locality off Central West Africa, with which it geographically links the Northeastern and Southeastern Atlantic representatives of the genus.

DESCRIPTION OF THE HOLOTYPE

For detailed morphometrics and meristics see table I.

External morphology (figs. 1-6)

Disc almost heart-shaped, $1.3 \times$ as broad as long, axis of maximum width at about 65 % of disc length behind level of shoulder girdle. Anterior margins strongly undulated in this adult male, i.e. weakly concave immediately behind snout tip, strongly convex at level of snout length and orbits, and deeply concave again at level of spiracles and nape. Outer pectoral corners broadly rounded and continuous with the relatively short, evenly convex posterior margins. Inner pectoral corners narrowly rounded. Pectoral axils deeply incised to origin of anterior pelvic lobe. Snout very short, its preorbital length only $2.2 \times$ the interorbital width, roundish and bluntly angled (135°). Tip of snout marked off as a short triangular projection. Orbits very large, their horizontal diameter about $1.5 \times$ the interorbital width and 70 % of the preorbital snout length. Spiracles only half as long as the orbits, interspace between them twice as wide as the interorbital distance. Eight pseudobranchial folds in each spiracle. Pelvics large, with a slender and pointed anterior lobe about two thirds as long as the posterior lobe. Both lobes separated by a deep notch. Claspers with pointed tips, fully developed and extended to about 40 % of tail

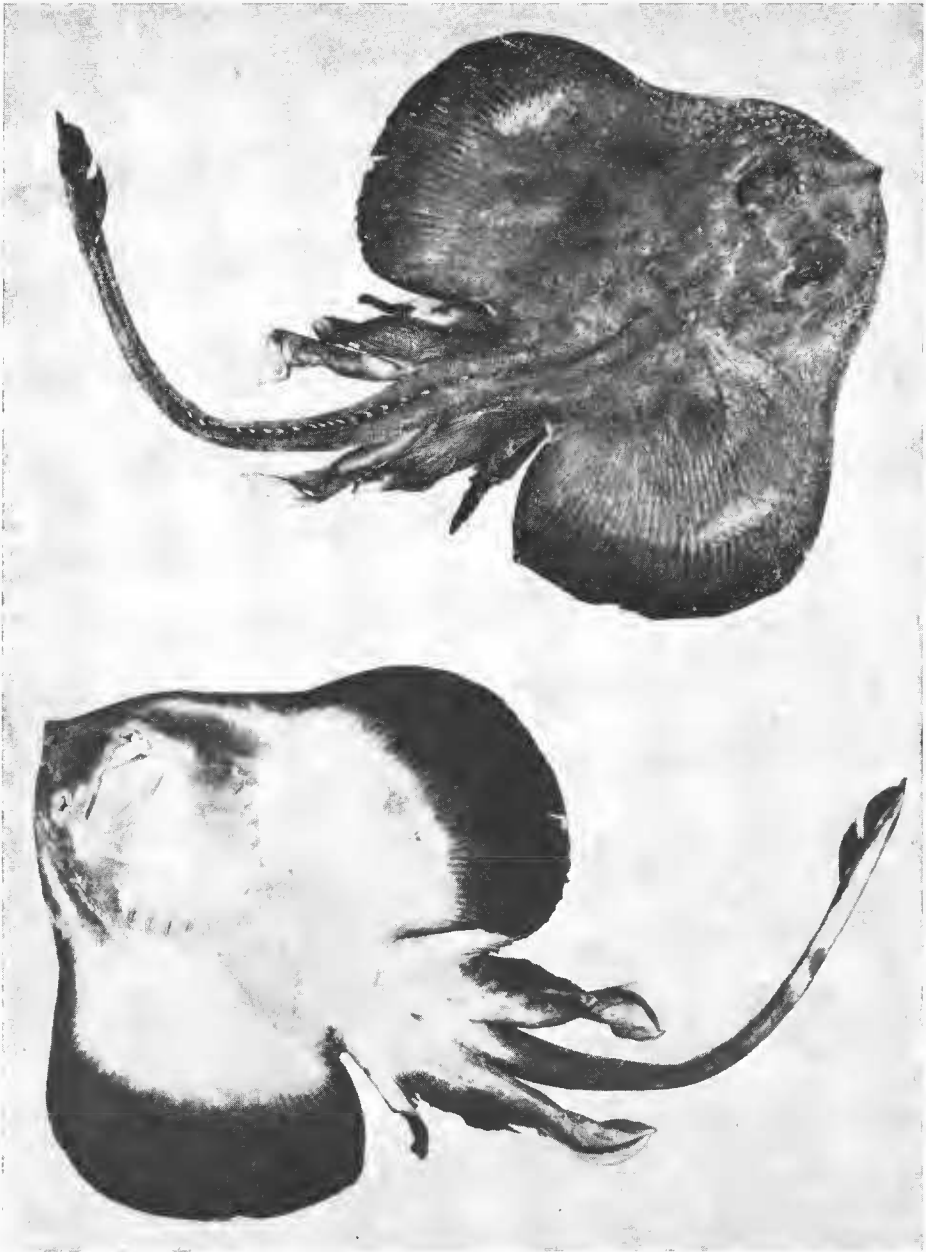


FIG. 1. — *Breviraja africana* sp. n.; holotype ♂ MNHN 1983-1 in dorsal and ventral view.

ength. The glans extremely dilatated in the left, less so in the right elasper. Tail long and slender, almost 60 % of the specimen's total length, obviously depressed over its whole length, a low oval in cross-section. Lateral tail folds short, in the posterior third of tail length, only one fifth of the total length. Folds widening at level of dorsal fins and terminating distinctly anterior to tip of tail level with end of second dorsal. The small dorsal fins at the very end of tail, their bases confluent at level of about half their vertical hight, which is about 50 % of their base length. Second dorsal somewhat smaller than first, both similar in shape with a steep ascending anterior, and a broadly rounded upper margin, a fan-shaped apex, and a posterior margin angled in forward direction. Postdorsal section of tail extremely short, only about 40 % of the D2 base length. Caudal fin a low, evenly high fold continued ventrally as a very low fold, resp. ridge to below D2. Preoral snout length almost equal to width of mouth, the latter being about 40 % of the ventral head length, which is about $3 \times$ the internasal width. Distance between fifth gill slits about 60 % of that between first gill slits, the latter distance being $2 \times$ the internasal width. Nostrils with a low fleshy flap somewhat extended laterally as a trapezoid tip with short fringes at its edge. Nasal curtain subrectangular, with undulated outer margins, rounded apices, and almost transverse rear margins, which are set with short forked lobelets nearly to the isthmus. No oronasal pits. Jaws protruded in an unnatural position, straight normally apart from the median convexity in upper and lower jaw. 46 close set obliquely parallel tooth rows in upper jaw. Individual tooth in median third of jaws with erect, long awl-shaped tip on subquadratic base. Shape of teeth gradually changing toward corners of mouth in showing low conical central eusp on a broadly rectangular base. Anteriormost pectoral radials and propterygia extended forward over full rostral length and almost in contact with rostral tip.

Upper surface more or less densely set with coarse spinules, including orbits, dorsal and caudal fins. Snout tip smooth as well as centers of pectorals and sides of trunk, a broad strip along posterior pectoral margins, a narrow median strip along tail to D1, and both pelvic lobes, but upper surface of elaspers prickly. A wedge-shaped area of hooked thornlets in malar region continued as a broad strip of very coarse spinules along remaining anterior pectoral margin onto the entire pectoral apex. Spinules along sides of tail also distinctly coarser. Lower side completely smooth.

Four small hooked thorns in line in preorbital position on left, three on right side, and two postorbital ones respectively. A similar small thorn on each inner shoulder. A median row of 17 (15th lost) larger, curved thorns along only the anterior three fifths of tail length from about level of pelvic axils to shortly behind elasper tips, their size decreasing rearward. A short strip of pointed alar thorns on each inner pectoral apex consisting of three longitudinal rows, each row with 5-7 thorns. No thorns on snout, nape, back of trunk, and the posterior tail section in front of first dorsal.

Colouration (in alcohol) brown without any patterning on upper side, lighter along median axis of disc and on pectorals, darker to margins of disc and pelvics, on elaspers and on tail. Dorsal and caudal fins blackish-brown, lateral tail folds marbled brown with some white. Side areas of rostrum not marked off, but anterior part of nasal capsules dark brown, and a transverse strip of ochre across posterior part of nasal capsules and interorbital space. Orbits blackish. Areas of alar thorns marked lighter brown. Anterior pelvic lobes blackish brown towards their tips, a broad transverse band of creamy white

across the middle of left lobe only. Tips of posterior pelvic lobes with a creamy blotch at outer margin, more distinct on right than on left lobe. Basal part of claspers somewhat lighter brown than terminal region. Several irregular indistinct dark brown cross-bars over tail length. Lower side of disc predominantly white, but a dark brown disc border very broad at outer corners and posterior margins, much narrower at anterior margins. The entire prenasal snout region and a strip from outer nostrils to level of first gill slits over propterygia also brown. Distal third of anterior pelvic lobes as well as almost the entire posterior lobes dark brown, except for their distal white blotches also shown dorsally. Claspers brown except for white basal third, but lighter in terminal region. Base of tail as well as posterior third white, with a few brown spots and blotches in latter part. Remaining area of tail plain dark brown. When freshly caught, the specimen showed dorsally a distinct bluish shade on orbits, margins of disc and pelvics, and over gill area. Below the outer margins of disc and pelvics were blackish, whereas tail and inner pelvic areas were marked off in brown.



FIG. 2. — *Breviraja africana* sp. n.; holotype ♂ MNHN 1983-1, mouth and nasal region.

Claspers (figs. 3-5).

External description based on right clasper due to the extreme dilatation of the left clasper.

Claspers moderately elongate and slender, the terminal region hardly marked off from proximal part. Outer surface of dorsal lobe with a very long and deep pseudosiphon (ps), the inner margin of which is supported by the dT1-cartilage in its distal third, whereas the proximal two thirds are bordered by and imbedded in the dorsal dilatator musele. Outer dorsal surface densely set with fine dermal denticles (dd), except for the area of the dilatator musele and the deeper pseudosiphon groove, which is as long as the terminal egiion and is located wholly proximally to it.

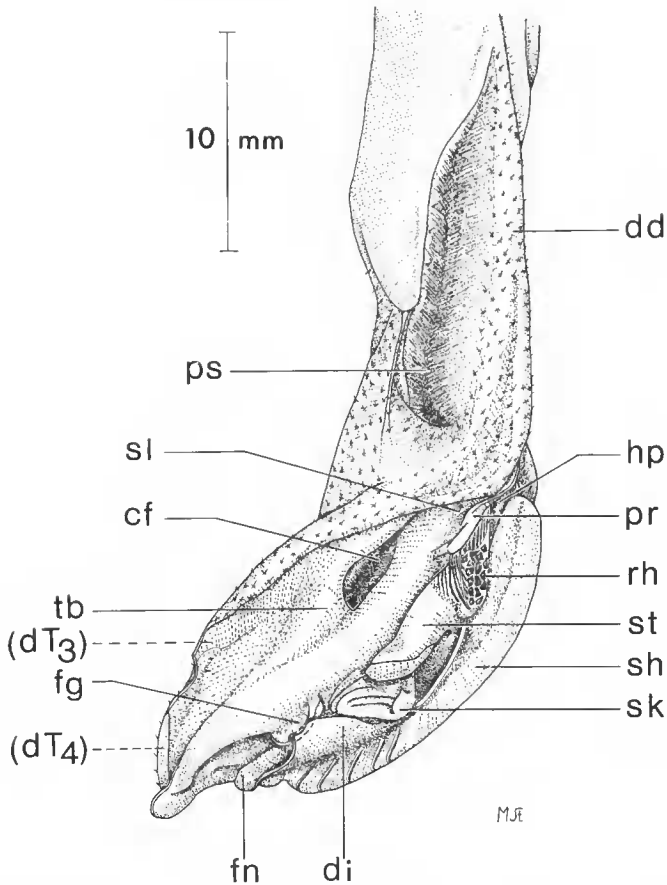


FIG. 3. — *Breviraja africana* sp. n.; holotype ♂ MNHN 1983-1, naturally dilatated right glans clasper. cf : cleft; dd : dermal denticles; di : dike; fg : flag; fn : funnel; hp : hypopyle; pr : pseudorhipidion; ps : pseudosiphon; rh : rhipidion; sh : shield; sk : spike; sl : slit; st : sentinel; tb : terminal bridge; dT3 and dT4 : position of dorsal terminal cartilages 3 and 4.

On inner dorsal lobe a deep proximal cleft (cf), placed longitudinally between axial, dorsal terminal 2, and terminal bridge (tb). An oblique oriented slit (sl) overlying proximal end of cleft and terminating inward at proximal midline of glans at the low vertical wall

of the pseudorhipidion (pr), the distal end of which is hidden in a continued fleshy fold. No further components in distal part of the dorsal lobe. Its outer margin, however, supported proximally by the dT3, and distally by the dT4, with an unsupported space between both cartilages.

Dominant component on inner ventral lobe is the long shield (sh) extending over the proximal three quarters of the glans. Its outer cartilaginous edge free and sharp. Level with its distal end and along its inner margin a distinct dike (di), which is a thin, almost vertically oriented cartilaginous wall covered with thin integument and somewhat curved inward. Distal end of both shield and dike is the horizontal tongue-like funnel (fn). Large fingerlike sentinel (st) arising at inner proximal half of shield and entirely covered with integument. Below its tip a broadly triangular spike (sk), which has upward curved claw-like free cartilaginous tip. Proximally on base of sentinel a small, fan-shaped rhipidion (rh). Its whole inner surface structured with longitudinal lamellae, outer surface with large pores distally, but with lamellae towards its insertion. About level with the dike, a rudimentary but distinct flag (fg) in midline on axial cartilage.

Inner surfaces of glans creamy white, with the following areas, or components sooty-grey and/or brown : pseudosiphon entirely so as is outer dorsal lobe, integument flap over pseudorhipidion dark grey. However, loose pigmentation in proximal half of shield, outer surface of dike, distal end of axial cartilage and its vicinity on dorsal lobe, base of sentinel, inner side of the dorsal lobe integument edge, and marginal parts proximally on dorsal lobe.

The clasper skeleton (figs. 4-5), dissected from the left clasper, consists of four dorsal, two accessory terminal cartilages, and a ventral terminal element grouped around the axial in the glans part. Axial (Ax) with a pointed distal end. Ventral marginal (vM) almost spoon-shaped distally, while the dorsal marginal (dM) shows a truncate distal end with a plate-like extension, this externally forming the pseudorhipidion. Beta-cartilage a relatively long, slender, plate-like element inserting at the dorsal part of the double-headed Ax-end and extending proximally to half the length of the b1-element. Dorsal terminal 1 (dT1) (fig. 5a) very large, curved around the axial onto ventral side and with a long, pointed proximal extension, which supports the inner edge of the pseudosiphon in its distal third. Distally the dT1 is firmly connected with the large ventral terminal (vT) (fig. 5 a) on the ventral side of the skeleton. The outer lamella of the vT forms the shield, the short distal extension the funnel, and the broadly triangular, plate-like extension in the distal third forming the dike in curving upwards from the dorsal surface of the vT. Proximally the vT shows a distinct notch and a short conical process, which links this element with the ventral surface of the accessory terminal 1 (aT1). The distal extension of the latter of the dorsal side forms the sentinel. Spike formed by the distal end of the accessory terminal 2 (aT2). Both the latter cartilages illustrated separately in figures 5 b + c. Dorsal terminal 2 (dT2) subquadrangular, with long slender, obliquely oriented distal extension, which is fused with the inner proximal edge of the dT3. Dorsal terminal 3 fused with outer edge of dT2-extension, and ending distally within the integument. Inner corner of dT3 connected with proximal end of the small rod-like terminal bridge cartilage (tb), which links the dT3 and the axial. The small plate-like and almost uncalcified dorsal terminal 4 (dT4) so delicate, that it could not be isolated from the firm tissue. It is distally fused with the axial, and ends freely within the integument proximally.

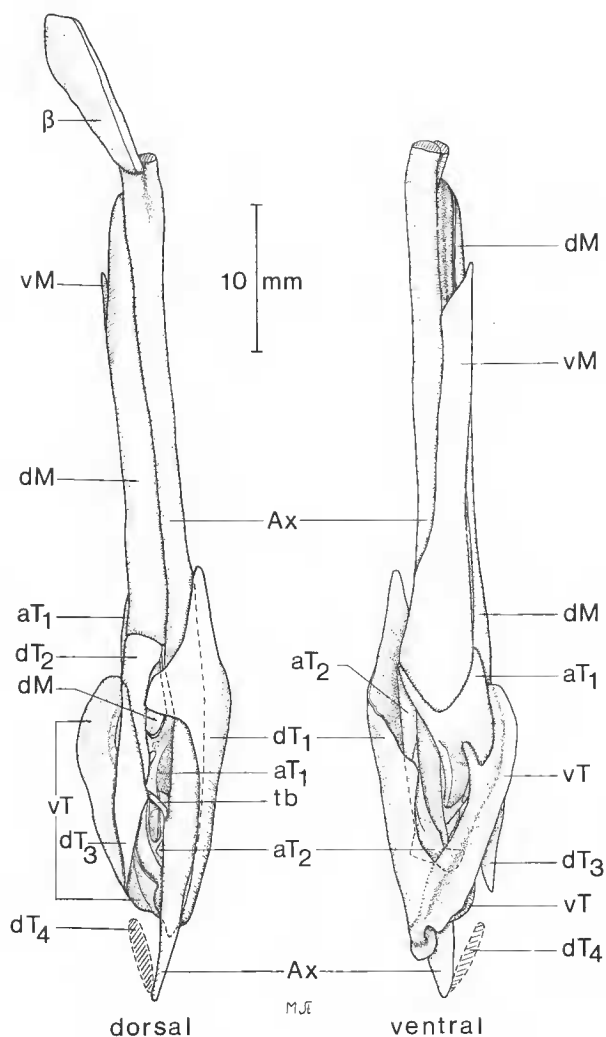


FIG. 4. — *Breviraja africana* sp. n.; holotype ♂ MNHN 1983-1, left clasper skeleton in dorsal and ventral view.

β : beta cartilage of basal group ; Ax : axial ; dM and vM : dorsal and ventral marginal ; aT1 and aT2 : accessory terminals 1 and 2 ; dT1-dT4 : dorsal terminals 1 through 4 ; vT : ventral terminal ; th : terminal bridge.

Pelvic girdle (fig. 6 a, after radiograph)

Relatively small, its maximum width 75 % of that of the pectoral girdle. Front edge almost straight, rear edge a deeply concave rounded arc. Prepelvic processes short and massive, bluntly pointed, and oriented obliquely outward. Long iliac processes greatly curved inward and forward. Two iliac foramina.

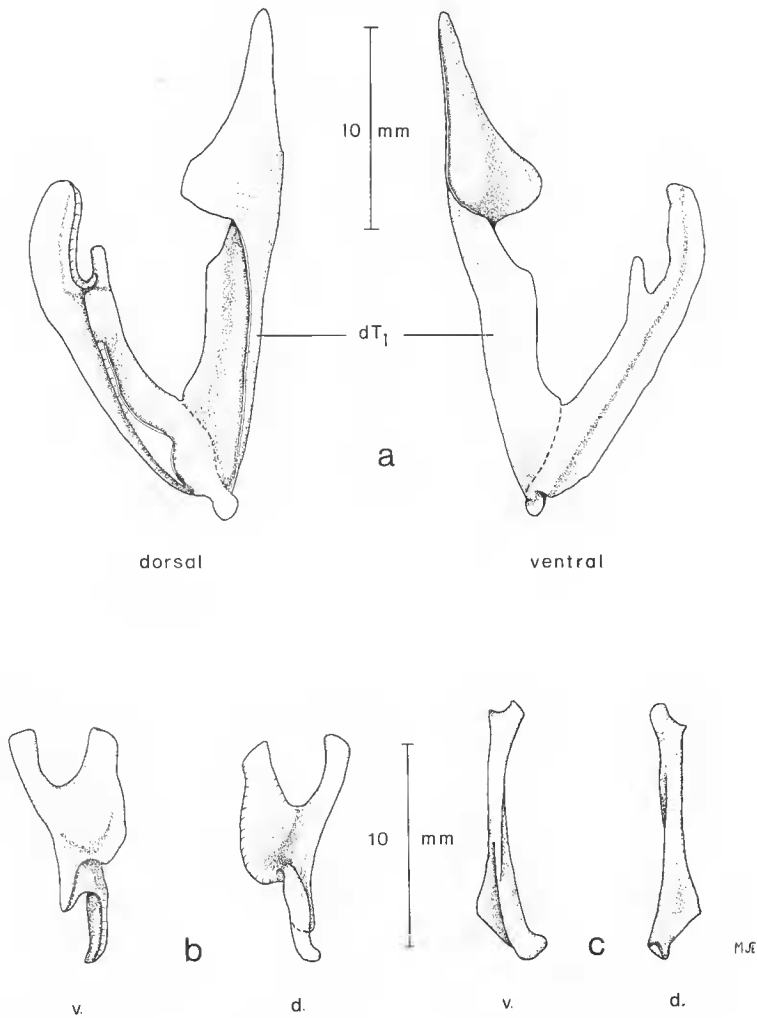


FIG. 5. — *Breviraja africana* sp. n.; holotype ♂ MNHN 1983-1, cartilages of left clasper in dorsal and ventral view; a, fused dorsal terminal 1 and ventral terminal; b, accessory terminal 1; c, accessory terminal 2.

Pectoral girdle (after radiograph)

Maximum width $1.3 \times$ that of the pelvic girdle and almost equal to greatest cranial width. Mesocondyle of scapulocoracoid equidistant from procondyle and metacondyle.

Neurocranium (after radiograph)

Rostral cartilage short, only 34.4 % of length of the cranium. Its basal part a moderately wide triangle, basal width 16.7 % of greatest cranial width, but abruptly tapering

distally. Distal third and appendices not visible in radiograph. Nasal capsules very large and broadly extended. Their front edge greatly bulging, the rear edge moderately concave. Maximum cranial width 73.3 % of cranial length. Nasal capsules slightly angled forward at 73° to longitudinal axis of cranium. Nasobasal fenestrae absent. Orbital region long, greatly constricted, with rounded edges, preorbital processes poorly developed. Least interorbital width dorsally 29.4 % of cranial width. Otic region long and wide, its maximum width 63.3 % of cranial width. Postorbital processes distinct as short, broad triangles clearly separated from the slender pterotic processes. Jugal arches moderately developed, neither laterally, nor to rear exceeding the contour of the occiput. Anterior fontanelle an elongate rather narrow triangle with concave rear edge. Posterior fontanelle narrowly club-shaped, moderately constricted medially and rounded at both ends, the broader part to the rear. Its length somewhat greater than that of the anterior fontanelle and 35.5 % of cranial width.

Vtr : 24, Vprd : 69, pectoral radials : 63.

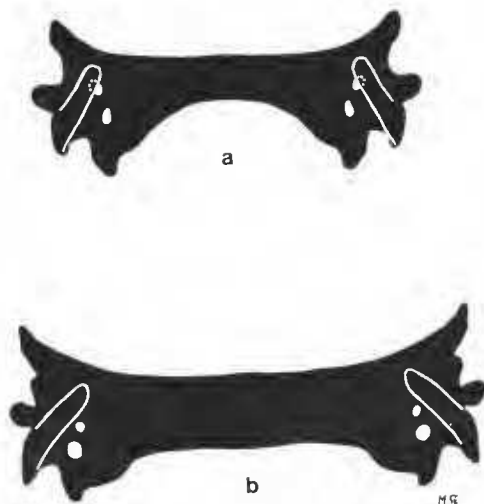


FIG. 6. — *Breviraja africana* sp. n. ; pelvic girdles of (a) holotype ♂ and (b) MNHN paratype ♀, somewhat schematized after radiographs. 2 × natural size.

DESCRIPTION OF THE PARATYPE FEMALES (figs. 7-10)

For detailed morphometrics and meristics see table 1.

External morphology

In general the same as the holotype, except for typical female features and the few head measurements, which in the male are due to artificial distortion of the jaws.

Disc clearly heart-shaped, 1.2 × as broad as long, axis of greatest width at about 63-70 % of disc length behind level of shoulder girdle. Anterior margins very weakly undulated

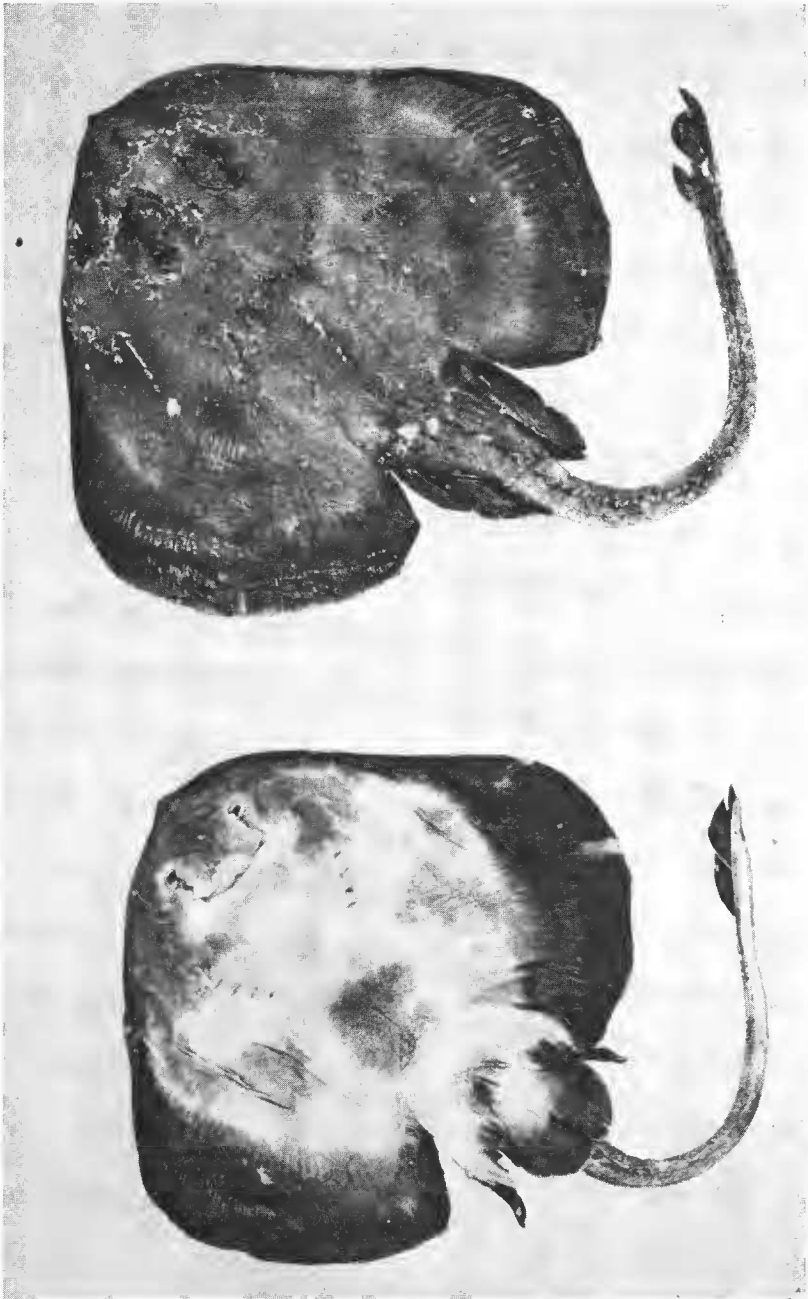


FIG. 7. — *Breviraja africana* sp. n. ; paratype ♀ ISH 129/80 in dorsal, paratype ♀ MNHN 1983-2 in ventra view.

to almost evenly convex, resp. straight in the median third, as is usual and contrary to males. Preorbital snout length $2.5 \times$ as long as the interorbital width. Snout rounded and bluntly angled (137°), its tip marked as a short triangular integumental process. Orbit diameter $1.4-1.8 \times$ the interorbital width and about 57-71 % of preorbital snout length. Orbits $1.9-2.5 \times$ as long as spiraeles, interspace between the latter $2.2 \times$ wider than interorbital width. 7-9 pseudobranchial folds in spiraele. Anterior pelvic lobe two thirds of the length of the posterior lobe. Length of tail and its lateral folds in relation to TL as in holotype, but shape in cross-section a low trapezoid rather than an oval as in the male. Tail folds ending distinctly in front of tail tip. Short postdorsal tail section 45-69 % of D2 base length. Preoral snout length $1.3 \times$ as long as width of mouth, the latter being 34 % of the ventral head length, which is $3.3-3.4 \times$ the internasal width. Distance between fifth gill slits 59-62 % of that between first gill slits, the latter distance being $2.4 \times$ the internasal width. Nostrils and nasal curtain (fig. 8) as in holotype, no oronasal pits. Jaws straight apart from the median convexity. 45, resp. 49 close-set tooth rows in upper jaw in quincunx arrangement. Individual tooth, at least in the median section of jaws, showing clear sexual dimorphism in having rhomboid flattened base with a very low conical cusp at center or toward the inner corner. Anteriormost pectoral radials and propterygia extending almost to snout tip.

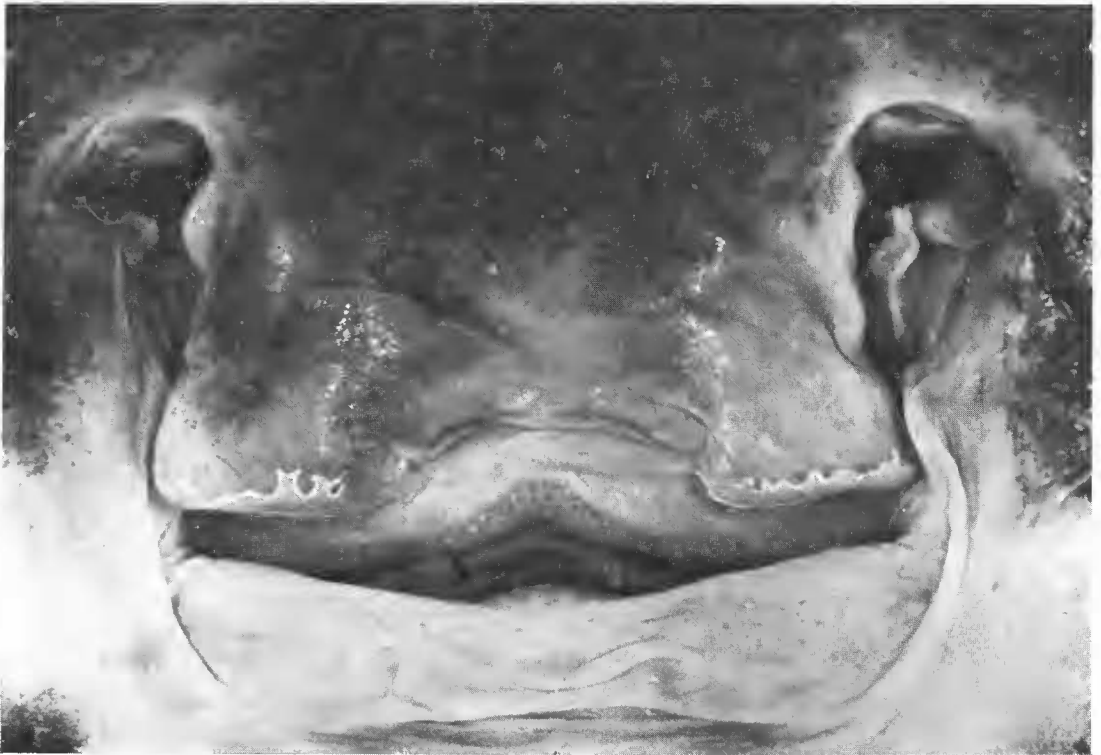


FIG. 8. — *Breviraja africana* sp. n.; paratype ♀ ISH 129/80, mouth and nasal region.

Apart from usual sexual dimorphism, spinulation and thorn pattern as in the holotype male. Upper surface entirely prickly, except for tip of snout and a strip along posterior disc margins, a narrow median strip along tail from end of the thorn row to the D1, and anterior pelvic lobe, but a central patch of spinules on posterior lobe. Smaller female with three preorbital and three postorbital thorns on each side, a posterior median nuchal thorn, and a scapular thorn on either side. A suprascapular thorn may be worn off. Larger female with four preorbital thorns on left side, three on the right, and two in left, one in right postorbital position. Also a median nuchal thorn posteriorly, but a thorn on left shoulder only. Median row of thorns only along anterior three fifths of tail from about level of pectoral axils, 27 (2 lost) in the smaller, 28 (1 lost) in the larger female, the line continued in both as a shallow groove to first dorsal fin without spinules or thorns. Lower side smooth in both specimens, except for an irregular narrow marginal strip of spinules along the tail, the spinules encroaching from the sides of the tail.

Colouration (in alcohol) plain dark greyish-brown above, darker to margins of disc and posterior pelvic lobes. About five indistinct dark brown cross-bars over length of the tail. In the smaller paratype dorsally a white spot on middle of right anterior pelvic lobe, also one at upper margin of first dorsal fin, and furthermore a large milky blotch at right snout margin and two whitish markings at left pectoral apex. Lateral tail folds milky white with some darker marbling. Lower side (fig. 7) generally as in holotype, but a large brown blotch on belly and irregular brown blotching along each pectoral origin. Head brown to level of first gill slits, only margins of nostrils and nasal curtain as well as jaws white. Except for its rear edge, anus surrounded with sooty brown.

The larger paratype dorsally (fig. 7) with a white spot at about middle of left pectoral fin, two further ones in oblique orientation over left side of pelvis area, one at right side of tail at level of tip of pelvic, and one anteriorly at left side of second dorsal fin base. Lateral tail folds marbled brown and white. Lower side as in smaller female, but white center of disc extended forward as wedge-shaped areas at sides of head and also to lower jaw as in the holotype.

Tail brown in both paratypes to below first dorsal fin, remaining part white marbled with brown.

When freshly caught, both females showed the same bluish shade on margins of disc, pelvis, and head as the holotype. Disc margins below were also blackish, the tail as well as blotching in the center of the disc were brown, this latter pattern lacking in the male.

Pelvic girdle (fig. 6 b, after radiograph)

Maximum width 72 % and 68.5 % of the pectoral girdle width for the smaller and larger paratypes respectively. Front edge as well as the rear edge almost straight, the latter formed as a shallow broad trapezoid. Otherwise as in holotype. Figures 6 a + b show the same distinct sexual dimorphism discovered already in the Northeastern Atlantic *Breviraja caerulea* by STEHMANN (1976 b).

Pectoral girdle (after radiograph)

Maximum width 1.4 and 1.5 × that of the pelvic girdle, 1.2 and 1.3 × as wide as the maximum cranial width for the smaller and larger paratypes respectively. Mesocondyle

of scapulocoracoid in both females almost equidistant from both the other condyles. As compared with the male, there is an obvious sexual dimorphism also in that the pectoral girdle is distinctly wider in relation to the pelvic girdle as well as to the cranial width. This has also been stated for *Breviraja caerulea* by STEHMANN (1976 b).

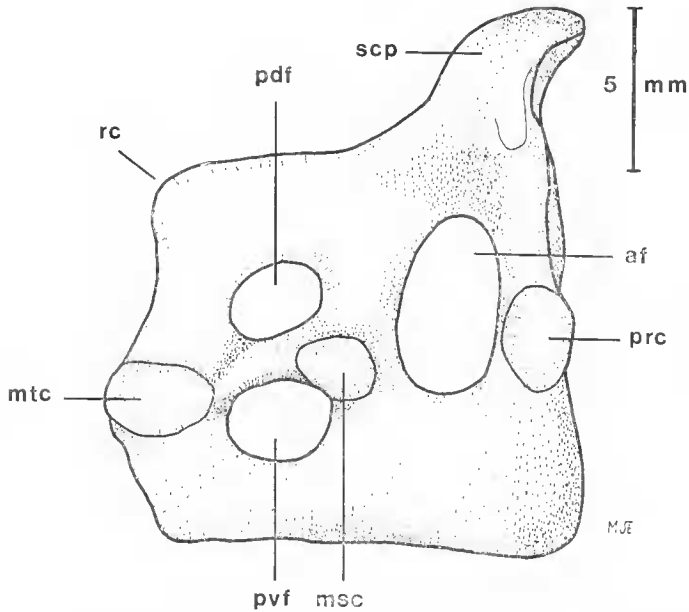


FIG. 9. — *Breviraja africana* sp. n.; paratype ♀ MNHN 1983-2, right scapulocoracoid.

af : anterior fenestra ; msc : mesocondyle ; mtc : metacondyle ; pdf : postdorsal fenestra ; prc : procondyle ; pvf : postventral foramen ; rc : rear corner ; scp : scapular process.

Scapulocoracoid (fig. 9) dissected from the smaller MNHN paratype. It is subquadrangular in shape, only a little higher than long. Mesocondyle slightly anterior of mid-length. Postdorsal and postventral foramina single and expanded, anterodorsal foramen distinctly so. Dorsal margin eoneave, but rear corner not elevated, and postdorsal margin abruptly sloping.

Neurocranium (fig. 10)

Illustration based on radiograph of the smaller female, the rostral features added by dissection of the same specimen. Neurocrania of both paratypes generally in accordance with that of the holotype. For the comparison of proportions with the male, those of the smaller paratype come first. Length of rostral cartilage 37.6 % and 34.4 % of the cranial length. Width of rostral base 14.6 % and 17.4 % of the cranial width, the latter being 72.2 % and 71.2 % of the cranial length. Least interorbital width dorsally 26.3 % and 27.9 % of the cranial width, of which latter the width of the otic region is 61.4 % and

TABLE I. — *Breviraja africana* sp. n. Actual measurements (in mm) for the three type specimens of external morphology and anatomical structures, and meristics (columns I-III). Range of proportions in per cent of total length (column IV). « ... » indicates measurements of distorted regions.

	I Holotype ♂	II Paratype ♀ MNHN	III Paratype ♀ ISH	IV
Total length	288.0	284.0	304.0	100.0
Disc, width	170.0	157.0	169.0	55.3-59.0
length	133.0	135.0	138.0	45.4-47.5
Snout, preorbital length	22.0	24.8	24.7	7.6-8.7
Orbit diameter	15.3	14.1	17.6	5.0-5.8
Interorbital width	10.0	10.0	9.7	3.2-3.5
Spiracle	8.0	7.5	7.0	2.3-2.8
Interspiracular width	20.4	21.5	21.0	6.9-7.6
Orbit + spiracle	18.0	16.5	18.9	5.8-6.3
D 1, height	9.4	7.0	9.8	2.5-3.3
base length	17.0	15.0	13.0	4.3-5.9
D 2, height	7.5	7.9	8.7	2.6-2.9
base length	15.2	15.9	15.0	4.9-5.6
Distance D 1-D 2	0	0	0	0
C, base length	5.9	7.1	10.4	2.0-3.4
Tail, postdorsal length	5.9	7.1	10.4	2.0-3.4
height at V-tips	7.2	7.7	8.1	2.5-2.7
width at V-tips	10.0	10.0	11.0	3.5-3.6
height at D 1 origin	2.7	2.8	3.0	0.9-1.0
width at D 1 origin	5.5	5.4	5.0	1.6-1.9
Lateral tail folds, length	60.0	63.5	68.9	20.8-22.7
Snout, preoral length	« 24.7 »	28.5	30.5	8.6-10.0
prenasal length	18.5	20.2	20.5	6.4-7.1
Head length, ventrally	67.0	65.0	67.0	22.0-23.3
Mouth width	« 26.0 »	22.0	23.0	7.6-9.0
Internasal width	20.3	19.5	19.5	6.4-7.0
Nasal curtain, length	10.0	13.2	13.5	3.5-4.6
width of each lobe	7.2	7.6	8.2	2.5-2.8
distance between lobes	« 11.0 »	9.5	8.7	2.9-3.8

Length gill slit, 1st	3.6	3.7	3.6	1.2-1.3
3rd	4.4	4.1	4.2	1.4-1.5
5th	3.0	2.9	3.4	1.0-1.1
Interbranchial width, 1st'	37.0	40.9	41.8	12.8-14.4
5 th'	21.0	25.4	24.7	7.3-8.9
V, length anterior lobe	38.0	40.0	41.0	13.2-14.1
Clasper, postanus length	64.0	—	—	—
Snout-middle of anus	121.0	116.0	127.0	40.8-42.0
Middle of anus — D 1	131.0	129.0	136.0	44.7-45.5
— D 2	149.0	141.5	151.0	49.7-51.7
— tip of tail	169.0	166.5	175.0	57.6-58.7
Snout — max. disc width	87.0	85.0	96.0	63.0-69.6
				of disc length

Angle of snout	135°	137°	137°
Tooth rows upper jaw	46	45	49
Pseudobranchial folds, left/right	8/8	7/7	9/9
Vtr	24	23	24
Vprd	69	70	68
P-radials left/right	63/63	61+ /62+	63/63

Neurocranium, TL	45.0	47.4	48.0
Rostrum, length	15.5	17.8	16.5
Max. width cranium	33.0	34.2	34.4
Min. dorsal interorbital width	9.7	9.0	9.6
Max. width otic region	20.9	21.0	20.5
Max. width at jugal arches	19.8	19.0	19.0
Width rostral base	5.5	5.0	6.0
Post. fontanelle, length	11.7	13.0	14.0
Post. angle nasal capsules	73°	ca. 76°	71°
Pelvic girdle, max. width	25.9	30.0	31.7
Pectoral girdle, max. width	34.2	41.8	46.3
Scapulocoracoid, length	13.2 (x-ray)	13.8	15.5 (x-ray)
height	—	16.3	—
pre - msc - length	6.0 (x-ray)	6.7	7.8 (x-ray)
post - msc - length	6.2 (x-ray)	7.1	7.3 (x-ray)
number pvf	—	1	—

59.6 %. Anterior fontanelle somewhat shorter than the posterior one, the length of which is 38 % and 40.7 % of the cranial width. Nasal capsules at an angle of 76° and 71° to the longitudinal axis of the skull.

Rostral cartilage abruptly tapering after basal triangle to form an uncalcified delicate bar, which undulates laterally as well as vertically and is joined to the median notch of the rostral appendices. These are delicate plates, with a large distal foramen and a slender, vertically undulated extension reaching rearward over two thirds of rostral length, but these long ends free of the rostrum. Anterior fontanelle as well as the posterior are similar in the three types, except for a slight modification in the larger 1SH paratype. The narrow anterior part of the posterior fontanelle in this specimen is as long as the posterior part and shows almost straight edges, i.e. no real median constriction exists.

Vtr : 23 and 24, Vprd : 70 and 68, pectoral radials : 61-63.

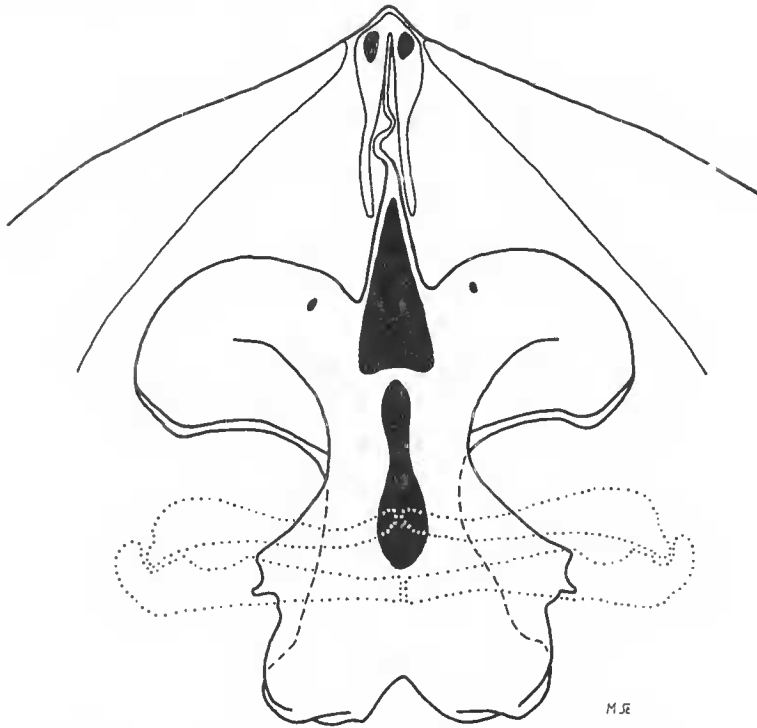


FIG. 10. — *Breviraja africana* sp. n.; paratype ♀ MNHN 1983-2; neurocranium and snout skeleton, somewhat schematized in combination of radiograph and dissection. $1.92 \times$ natural size.

INTERSPECIFIC COMPARISON

The only congeners known to also possess an external elasper pseudosiphon are the Northwestern Atlantic *B. colesi* Bigelow & Schroeder, 1948, and *B. spinosa* Bigelow & Schroeder, 1950 (McEachran & Compagno, 1982). However, both these species have

short and stout anterior pelvic lobes, a different and heavier thorn pattern (especially *B. spinosa*). Furthermore, *B. colesi* shows a constant pattern of dark and light spots and blotches on the upper side. Additionally, both species possess the components promontory and hook in glans elasper and show corresponding modifications of the dorsal terminal 2 and 3 cartilages. Also sentinel and spike in both are located obviously distally within the glans (McEACHRAN & COMPAGNO, 1982).

Nothing is known with regard to elasper characters for *B. mamillidens* (Aleoek, 1889) and a *Breviraja* sp. from the Indian and Indopacific Oceans. However, the former species (the holotype and only specimen lost) described as "uniform jet-black throughout", has separate dorsal fins and a continuous median row of about 30 thorns from nape to first dorsal fin. The latter Indopacific species is known from three juvenile males only, which have no thorns on disc other than a single preorbital one on each side, a median row of about 40 tail thorns from level of pelvic axils to first dorsal fin, and separate dorsal fins. Both these species have been redescribed, discussed, and assigned to *Breviraja* by STEHMANN (1976 a).

Another new *Breviraja* (or *Neoraja*) species (Ms, McEACHRAN & STEHMANN) from the NW-Atlantic shows thorns also along midline of the body, furthermore (McEACHRAN & COMPAGNO, 1982) a rostral shaft failing to reach the rostral node, and a seapuloeoraeoid with an elevated rear corner as well as a diagonally sloping posterodorsal margin.

Yet another undescribed *Breviraja* species from Surinam waters, not completely investigated though (STEHMANN, unpubl. results), is similar to *B. spinosa* in shape and dorsal spinulation as well as the heavy thorn pattern, and possesses the elasper components pseudosiphon, hook and rudimentary promontory. However, its dorsal colouration is plain lead-grey to blackish-brown, and ventrally even darker in being uniformly blackish-brown. Hence, it differs from *B. africana* at least in colouration and several elasper characters.

Among the Eastern Atlantic congeners *B. stehmanni* Hulley, 1972, and *B. caerulea* Stehmann, 1976, lack an external elasper pseudosiphon as stated in their original descriptions. Their rostral shaft fails to reach the rostral node, and their seapuloeoraeoid has an elevated rear corner and a diagonally sloping posterodorsal margin (McEACHRAN & COMPAGNO, 1982).

An unnamed *Breviraja* species from the southern Bay of Biscay (STEHMANN, 1973, 1979) is very different in shape of the disc (adult male with straight anterior disc margins), has widely separated dorsal fins, and a median row of about 50 thorns from shoulder girdle onto the anterior two thirds of the tail. The single known specimen is in an advanced stage of decomposition and hence, presence or absence of a pseudosiphon in this adult male's elaspers cannot be stated with certainty, although its elasper skeleton (STEHMANN, unpubl. results) is very similar to that of *B. africana*.

Recently a number of juveniles of one more unknown *Breviraja* species have been obtained from moderately deep slope waters in the Northeastern Atlantic off the Iberian Peninsula. Although not yet investigated in detail (STEHMANN & BARO DOMINGUEZ, unpubl. results), this form is clearly distinct from *B. africana* in being light brown dorsally with an almost constant pattern of black dots and spots, and in having a plain white lower surface.

Finally, *B. africana* is distinct from *B. yucatanensis* Bigelow & Schroeder, 1950, *B. nigerima* De Buen, 1960, and *B. longicauda* De Buen, 1959. See discussion below.

DISCUSSION

The detailed generic revision by McEACHRAN & COMPAGNO (1982), based mainly on skeletal anatomy and clasper characters but somewhat neglecting external morphology, has resulted in splitting *Breviraja* Bigelow & Schroeder, 1948. They restricted the taxon to *B. colesi* and *B. spinosa*, and erected the new genus *Neoraja* for nine further species and subdivided it into the new subgenera *Neoraja* and *Fenestriaja*. These consist of the species *stehmanni* Hulley, 1972, *caerulea* Stehmann, 1976, and a new NW-Atlantic species (Ms in preparation by McEACHRAN & STEHMANN) for the former subgenus, and of *plutonia* Garman, 1881, *sibogae* Weber, 1913, *atripinna*, *cubensis*, *sinusmexicanus*, all three described by BIGELOW & SCHROEDER in 1950, and *ishiyamai* Bigelow & Schroeder, 1962, for the latter subgenus.

Apart from the above 11 species originally described as, or later assigned to *Breviraja*, McEACHRAN & COMPAGNO (1982) have revised, or commented on other nominal or valid species of the genus. They reallocated from *Breviraja* to *Raja* the Caribbean *B. yucatanensis* Bigelow & Schroeder, 1950, and the Chilean *B. nigerrima* De Buen, 1960. The Indian Ocean *B. mamillidens* (Alcock, 1889) was tentatively assigned to *Neoraja*.

However, these authors left open the generic status of three further species assigned to *Breviraja*.

Of these, *B. longicauda* De Buen, 1959, from Chile, the holotype and only known specimen is lost (McEACHRAN & COMPAGNO, 1982), was inadequately described and illustrated originally, so that its affiliation to any rajid genus could not be stated. Should this species one day after all prove to be a *Breviraja* or *Neoraja*, it would most probably not affect *B. africana*, because the occurrence of *B. longicauda* in the Eastern Central Atlantic is most unlikely.

A single old museum specimen, an adult male from the southern Bay of Biscay, had been confirmed as a *Breviraja* by STEHMANN (1973, 1979) and was recently described in its external appearance (STEHMANN & BÜRKELE, in press), but not named because of the bad condition of this Paris Museum specimen. It was also precisely described externally and perfectly illustrated by VAILLANT (1888) and available for skeletal anatomy investigations.

The third case are the three juveniles originally reported by WEBER (1913) from the Indopacific and identified as *Raja mamillidens* Alcock, 1889. STEHMANN (1976 a) described these three specimens in the Amsterdam Museum and assigned them to *Breviraja*, but did not name the species, which proved not to be identical with *Breviraja mamillidens* (Alcock, 1889), due to the juvenile stage of the three males and damage of the largest one.

Although it is admitted here that McEACHRAN & COMPAGNO (1982) were confronted with the circumstance of inadequate, or even missing material and partly insufficient original descriptions and illustrations, the present authors are nevertheless critical concerning the nomenclatorial consequences caused by the generic revision in the latter three cases, in that three species taxa originally described as, or later assigned to *Breviraja* have lost their generic assignment. In this connection it appears unimportant, whether or not these perhaps are valid species, or named specifically. Such a case should not happen in taxonomic work, the less so since the present authors believe that McEACHRAN & COMPAGNO

(1982) could have expressed and demonstrated their systematic conclusions in another nomenclatorial way as well. They could have, for example, provisionally subdivided *Breviraja* into three subgenera *Breviraja*, *Neoraja*, and *Fenestrija*, and thus could have kept the generic assignment for the critical species taxa, which could for any reason not be fully investigated and hence, could not be arranged in their actual classification concept. Exactly the same problem, intensified however through a much larger number of species of worldwide abundance and only hitherto partly investigated, has to date restrained rajid workers from raising the various subgenera of *Raja* Linnaeus, 1758, to generic rank.

After the above discussion of a more general nature related to the revision by McEACHRAN & COMPAGNO (1982), the present authors wish to explain briefly the evaluation of *B. africana* as intermediate between *Breviraja* and *Neoraja* sensu McEACHRAN & COMPAGNO (1982). Reference should be made to the revision of the latter authors for the full details of their generic and subgeneric diagnoses, which cannot be repeated here completely. Furthermore, a renewed consideration of the conclusions by McEACHRAN & COMPAGNO (1982) must await further investigation of the species concerned, including material of the newly discovered forms mentioned above. However, the present authors wish to explain with a few examples, why in their opinion *B. africana* indicates that the distinction between *Breviraja* and *Neoraja* appears somewhat weak and is perhaps to a certain degree artificial.

The generic diagnoses given by McEACHRAN & COMPAGNO (1982) have a number of characters, which are common to both genera. This is mainly due to the circumstance that a number of *Neoraja* generic features are stated with the alternative "present or absent", which distinction in fact mainly refers to the two subgenera of *Neoraja*, but is not specified as such.

Breviraja was characterized by these authors, among other features, in having a tail length of at most 60 % of the TL, a clasper with distinct pseudosiphon formed only by the dorsal dilatator muscle, a rostral shaft reaching rostral node and appendices, the latter being elongate and flattened, and a scapulocoracoid little expanded anteroposteriorly and with only one postventral foramen. These generic characters, e.g., are shared by *B. africana*, which lacks others such as, e.g., the thorn triangle over the nuchal/scapular region, short anterior pelvic lobes, oronasal pits, the components hook and promontory in glans clasper, a broad rostral base, moderately large rhomboidal nasal capsules, and well developed preorbital processes.

Neoraja was characterized by McEACHRAN & COMPAGNO (1982), among other features, in having separate nuchal and scapular thorns not forming a triangle, a short and broad integumental process at tip of snout, long anterior pelvic lobes, claspers moderately to very long and slender, clasper components flag and funnel, dM-cartilage with distal extension entering glans, rostral base relatively narrow, large ovoid nasal capsules, and poorly developed preorbital processes. These generic characters, e.g., are also shared by *B. africana*, which lacks again others such as, e.g., one or three distinct thorn rows along midline of disc, a tail length of generally more than 60 % of the TL, and a rostral shaft not reaching rostral node. Within *Neoraja*, *B. africana* is more similar to the subgenus *Neoraja* than to the subgenus *Fenestrija*, which latter is characterized, e.g., by having oronasal pits and nasal capsules with basal fenestrae, and through the lack of dermal denticles on the clasper, the lack of the dT1-cartilage and the anterior notch in vT-cartilage of clasper skeleton.

Additionally, *B. africana* shows unique features among the species so far arranged in *Breviraja* and *Neoraja*, in that it possesses four dT-cartilages, of which the dT4 joins the tip of the axial but is separated from the distal tip of the dT3. Furthermore, in that the distal extension of the dM-cartilage appears as the component pseudorhipidion typically in median proximal position of the glans clasper, and in that the distal third of the pseudosiphon groove is bordered and supported by the proximal outer edge of the dT1-cartilage.

Although the specific validity of *B. africana* is quite clear, its generic affiliation appears problematic with regard to the diagnostic characters combined by McEACHRAN & COMPAGNO (1982) to describe *Breviraja* and *Neoraja*. Apart from the above mentioned intermediate position of *B. africana*, the diagnoses given by the latter authors are themselves somewhat weak, contain partly unprecisely stated features (e.g. pattern of orbital thorns, patterns of dorsal and ventral colouration), and contain shared features. Furthermore, they mention in part characters not indicated in the specific descriptions and illustrations, such as the clasper component dike stated for *Breviraja*, but neither mentioned in the descriptions, nor indicated in figure 1 for *B. colesi* and *B. spinosa* (McEACHRAN & COMPAGNO, 1982 : 421, 402-403 respectively). The problem is further complicated, in that McEACHRAN (pers. comm., 1982) explained that the diagnostic generic characters should be understood in the light of their phylogenetic significance and interpretation mainly, through which viewpoints he strongly considered the present new species as a member of *Neoraja*, subgenus *Neoraja*.

The present authors do not intend to go into the very detail of such a basic discussion here (see above), but would like to underline at least two major objections against McEACHRAN's statement cited above. Firstly, significant characters combined in a diagnosis to describe a generic taxon is one thing, the interpretation and analysis of such characters under terms of phylogenetic systematics is another. To assign a species taxon to a genus means primarily its comparison to generic diagnoses with regard to presence or absence of relevant features, at most perhaps with regard to a relative development or reduction of such characters. Considering these points of view *B. africana* certainly appears intermediate between *Breviraja* and *Neoraja* of McEACHRAN & COMPAGNO (1982). Secondly, should the new species *africana* prove to be a member of *Neoraja* after a renewed consideration of the entire problem, then such important characters as a clasper pseudosiphon and a rostral shaft, which continues to join the rostral node and appendices, phyletically must have been developed independently twice.

Although the present authors admit, that such a case is not unusual in evolutionary processes, they nevertheless feel unable to decide on the actual problem. The knowledge, in our opinion, about intrafamilial relationships within the Rajidae and about the phyletic significance of certain characters is not sufficiently advanced, and in particular the revisional information given by McEACHRAN & COMPAGNO (1982) appears as an insufficient basis for the present case.

As a consequence, the present authors feel unable to assign with certainty the new species *africana* to either *Breviraja*, or *Neoraja* in the meaning of McEACHRAN & COMPAGNO (1982) and hence, the new species is preliminarily assigned to *Breviraja* sensu BIGELOW & SCHROEDER, 1948, and sensu ISHIYAMA & HUBBS (1968).

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